Laboratory of Solid State Chemistry (Special Issue on the Commemoration of the Fiftieth Anniversary)

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LABORATORY OF SOLID STATE CHEMISTRY

Head: Dr. Toshio Takada

Under the supervision of Professor T. Takada, various inorganic materials have been synthesized and the magnetic properties have been studied. The abstracts of major research are as the following.

I. Preparation of Transition Metal Oxides from Aqueous Solution

Iron oxides and hydroxides were formed in aqueous suspension media. The precipitates of ferromagnetic spinel ferrites, $M_xFe_{3-x}O_4$ (M=Mg, Co, Mn, Zn...) and barium ferrites were also prepared in aqueous solutions. The precipitated particles were crystallographically studied and their magnetic properties were elucidated. Recently the technique for the ferrite formation was proved to be very useful for excluding heavy metal ions from waste water.

II. Crystal Growth from Vapor Phase

Single crystals of ferrites, vanadium oxides, titanium oxides and some other oxides were grown by close-tube chemical transport method and their magnetic and electric properties were clarified. In order to study the mechanism of crystal growth from vapor phase, molecular species in the vapor phase were examined by a devised mass-spectrometer.

III. Mössbauer Effect Studies

Mössbauer effect has been utilized to elucidate the magnetic properties of many compounds and alloys. The electronic properties and magnetic ordering were studied in some Fe^{6+} compounds and the spin structures were estimated in $KFe_3(OH)_6(SO_4)_2$, $Fe(OH)_2$, and $Fe_3(PO_4)_28H_2O$. The cation distribution in ferrites was determined by applying an external field. The magnetic properties of ferromagnetic metal surface were studied by using Fe^{57} emission spectroscopy and also with vacuum evaporated thin films. Very low temperatures, such as 80 mK, were realized by a He^3-dilution refrigerator and a nuclear polarization of Co^{57} was observed in the Mössbauer emission spectrum.

IV. Magnetochemical Study of Organic Magnetic Materials (Activities of Professor H. Takaki's Group)

Professor H. Takaki and his coworkers have studied the magnetic properties of organic magnetic materials. Organic magnetic materials have some unpaired electrons in a molecule and exhibit magnetic properties like inorganic transition-metal com-

pounds. In order to study the magnetic behaviors and the mechanism of phase transition, the measurements of magnetic susceptibility, magnetic heat content, electron spin resonance (ESR) and nuclear magnetic resonance (NMR) have been carried out. The electron-nuclear double resonance (ENDOR) was also utilized to study the dynamical properties of the unpaired electrons. Published papers on these studies are included in the last part of the following publication list. Professor H. Takaki was retired from Kyoto University in 1973.

The low temperature laboratory was built in 1970 for the convenience of experiments at liquid helium temperature. A helium liquifier (Philips Phe 210) is equipped and liquid helium is always stored in a 500 l storage vessel (Cryenco). The evaporated helium gas is collected through the piping system and compressed and purified by an apparatus (Osaka-Sanso OHE-30). Some measurements like Mössbauer effect and magnetic susceptibility are routinely made at helium temperature region. Much lower temperatures than liquid helium are available by using a He^3-dilution refrigerator.

Publications

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Publications of Professor H. Takaki's Group

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